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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

Devoted to the Interests of Illumination, Heating, Ventilation and Sanitary Improvement, Domestic Economy, and General Science.

VOLUME XIX.—No. 10.] Whole No. 346. | NEW YORK, MONDAY, NOVEMBER 16, 1873. | $3 PER ANNUM IN ADVANCE.

[Communicated to this Journal by the Author.]

On Cannelite.

By Augustus A. Hayes.

This name has been applied to a carbonaceous mineral, occurring in Kings', Albert, and Westmoreland counties, New Brunswick. Under the name of Baltimore and Bituminous Shales, it has been long known and in connection with Albertite, has acquired considerable interest.

A few years since, Prof. H. Y. Hind and myself, were engaged in a careful exploration of parts of these counties, for minerals of economic value, and to determine the presence, or absence of petroleum, in reported localities.

The entire absence of bitumen in this mineral, its interest in a scientific connection, and value as a source of hydrocarbons, led us to distinguish it from all other hydrocarbon minerals, and name it Cannelite.

In geological position the mineral occurs in the lower Devonian rocks. Alternating beds of remarkable uniformity are shown at various sections, at Baizeley's Farm on Tuille Creek, and at several points; the extreme length of area on one line exceeding fifty miles. There are shaly aggregates, containing carbon more or less diffused through them, but this mineral does not pass into them by gradations, and preserves its physical character and chemical composition quite evenly throughout its beds. With the slight diversity which is seen in coal samples from different parts of the same mine, it agrees.

CHARACTERS OF CANNELITE.

Color.—Some shade of dark brown, streak, light yellowish brown, lustre, dull, earthy, fracture uneven, structure slightly lamellar. It is traversed everywhere by thin layers of Albertite. Often these are very thin and numerous in the thickness of an inch. When the layers are bent short, the Albertite is most abundant in the bends, and finally perfect mirror-like surfaces may be obtained by splitting the mineral at its layers. The general aspect of this body is that of finely divided, solidified mud, through which black, brilliant gum has been disposed in layers. Specific gravity varies from 1.353 to 1.396. Breaks with difficulty. The samples analyzed were taken from spots miles apart, and the results represent the extremes of variation.

ANALYSES OF CANNELITE.

The method pursued I shall describe now in detail; here the results are given as the basis of the economic value and fitness in application of this mineral, to gas manufacturing.

When heated this mineral crackles, gives off a slight odor of naphtha, with a little vapor of water. At a high temperature vapor of naphtha burning with a clear flame, followed by a denser oil, becoming smoky. In close vessels the fragments after heating to redness are slightly tumified.

The combustible matter burned off completely, leaves a light yellowish ash, occasionally dotted by darker spots. This ash is of the same composition as the sandstone in closing the beds. The unaltered mineral affords the same *cementing* salts as the sandstone rock, and may be taken as a mixture of the most finely divided silt of the rock, mixed with pulp of humus in water; subsequently cemented and consolidated under conditions favoring stratification. This fact has a scientific value.

The Cannelite becomes dry at 420° to 440° Fahr. One hundred parts afforded

	1.	2.	3.
Water vapor 240° C.	1.	1.	1.
Volatile inflam. matter	42.90	44.5	41.5
Carbon in coke	17.70	18.0	20.
Mineral matter	38.40	36.5	37.5
	100.	100.	100.

Viewed in the light these analyses afford, we have in Cannelite a congener of Torbane Hill mineral or Boghead coal, and as we are able to produce the hydrocarbon mineral of the Cannelite, mixed with, and disposed in, the silt of a sandstone, so we may suggest that the discussed Torbane Hill mineral is a more evenly mixed hydrocarbon mineral, with the silt of cannel coal—a fire-clay—without a trace of bitumen being present. Considered as representing Albert coal, Cannelite has a high economic value in the gas manufacture.

CANNELITE AS AN ENRICHER.

Albertite and Boghead coal have been placed at the head of the list of enrichers of illuminating gas. As it is my purpose to show why we so rate these two bodies so highly, at another time, I will confine my remarks to the practical point most prominent in this connection.

Albertite and Boghead coal in the 100 tons are represented by

	Albertite.	Boghead Coal.
Moisture afforded at 200° C.	0.5	1.50
Vol. inflam. matter	60.	62.00
Carbon in coke	38.	12..0
Ash	1.5	24.50
	100.	100.

Both of these coals are paraffine producing minerals, and hence the gas from them is charged with vapors which resist cooling well. We may therefore ascertain the comparative value of Cannelite, Albertite, and Boghead coal from their proportions of volume of inflammable matter afforded. Thus 60 represents a value of 100 Albertite then 42.9 equal, Cannelite worth 78.8 per cent. of it or Boghead coal being 62.5 Cannelite has a value of 68.6 per cent. Bath Cannelite and Boghead coal must be worked without mixture with coal; the gas formed from each being mixed as produced, with that of "basis" coal.

The present is a favorable time for substituting cheap basis coals, for better gas coals carrying the candle power of the gas higher, by the enricher used in a relatively small proportion.

All the beds of Cannelite are near water transportation; the more distant ones can be opened to tram ways having a descending grade to tidal rivers. The country is traversed by good roads, and the population interested in developing their resources.

Coal-Substitutes for Fuel.

A paper was read before the Manchester Scientific and Mechanical Society, recently, by Mr. J. Wormald, C.E., wherein he expressed a hope that the decline of the coal panic would not lead to the neglect of the subject of artificial fuels. The value of these fuels have never been sufficiently discussed in view of our increasing requirements, and had owed any little consideration that had been given to it solely to temporary advances in the price of coal. He did not understand why the manufacture of artificial fuel as an article of commercial value should not be considered in times when our normal fuel was cheap. There were millions of tons of really good fuel in the shape of smudge or waste annually thrown aside at the pit mouths, and though this material was capable of being made available for steam requirements by well-known processes, the most of it was allowed to deteriorate in heating power by exposure to the air for years, or until a coal panic suggested its utilisation.

An examination of the patent records for 100 years past showed little or no practical advance in the artificial fuel question. Coal dust and tar alone, or combined with other and many of them singular ingredients, had been brought into requisition during the 100 years, but practically the state of the question was the same now as then. By diagrams the reader of the paper showed the repetition in most of the patents of the ingredients used in the manufacture of fuels, and their proportions in which the principal variations of old patents consisted. The more original specifications had more resemblance to household receipts than to a solution of the difficulties of our coal supply, since the compounds suggested contained ingredients of such limited quantity, as tanners' bark, asphalt, resin, cut straw, and even the expensive and extraordinary ingredients of meal, rye flour, and gutta percha. In one specification blood was named as an ingredient: and in others seaweed and clay, were given in large proportions, though the fact that so little was known of any compound fuel of such cheap and simple ingredients was a most sufficient proof of their having failed. At the same time, admitting that any of these extraordinary mixtures gave a certain

percentage of heat, they could not meet the national requirements as a substitute for coal. Any such substitute must be simple, and not compound. Combinations were necessarily expensive.

Peat would be found to be the simple fuel, next to coal, in quantity of superficial area. The relative areas of coal and peat were: Coal, 7,750,000 acres: 6,000,000 acres. Peat had decidedly the advantage in being procurable on the surface of the ground, and whatever may have been the past difficulties in regard to drainage, the labor of getting it was to be encouraged in preference to the work of miners underground, which, on the other hand, should be continued by machinery. The calorific power of efficiently worked and well-dried peat, as compared with coal, averaged 75 per cent.

One of the reasons why a fuel so abundant was so little known was that it deposited a large quantity of water, the disposal of which, and the expense of bringing it to something near the same spacific gravity as coal, had proved great difficulties in the way of its being brought into competition with coal. But he maintained that it was of importance that even if coal were to come down to its former low standard, or to one even lower, the peat-fuel question must not be lost sight of. An examination of the results obtained in the old processes of drying fuel showed that to part with its great quantity of water it must be thoroughly broken up in the raw state, so as to sever the fibres, whose powers of capillary attraction retained the water, and subsequently exposed to the atmosphere for drying. Clayton's machinery, among recent inventions, seemed well adapted for preparing peat for fuel. Properly prepared peat giving a good heat, with a brighter fire, less smoke and smaller residue than coal, would be a favorite fuel for domestic use. It was to be hoped the time was not far distant when tracts of peat land now lying waste would be swarming with industrious laborers, whose work on the surface would help to lighten the labor required underground. A conversational discussion followed the reading of the paper, and a vote of thanks was unanimously accorded to Mr. Wormald for its preparation and delivery.—*London Mining Journal.*

Remarks on Condensation Products of Gas.

By Robert Gasch.

[Our readers will remember that in the report on sulphur purification by the late referees (see *Journal of Gas-Lighting* for April 23 1872, p. 346), they expressed an opinion, founded upon an observation of Mr. Kirkham, that sulphur compounds other than bisulphide of carbon are present in purified gas. We ourselves have never had a doubt as to the presence of such compounds, although no one has yet been isolated. The author of the paper, of which we give a short abstract below, has gone some length towards their identification, and gives strong reasons for supposing them to be mercaptans. It is a matter of scientific rather than practical interest, for the amount of these bodies present in gas must be exceedingly small; but the ordinary means of purification will fail to remove them.]

In renewing the pipes between the purifiers and gasometers at Dresden, the author obtained a small quantity of tar oil, and an abundance of the same substance was subsequently found floating on the water of the gasholders, and in various localities of the network of mains. When recently deposited this oil has a yellow color and is transparent, but in time it changes into a heavy, dark, black, tarry substance.

It is well known that the light benzole vapors are occasionally carried along with the gas, and that even the heavy naphthaline may be present in it, and it is not unreasonable to assume that all those hydrocarbons, whose boiling point is between that of benzole and naphthaline, may also occur in gas.

After collecting a quantity of these condensed products in several situations, the author subjected them to a slow fractional distillation, with the view of ascertaining the amounts of light and heavy oil and of naphthaline, the distillation being in each case carried on until naphthaline made its appearance at the outlet of a Liebeg's condenser, an occurrence which always took place very suddenly.

The results obtained by the distillation of the condensed products were as follows:

	Oils Collected.									
	From Gasometer.								From Syphons in town.	
	Before the Purifiers.				From E and D.		Under Cover.	Exposed to Air.		
Specific gravity							0·997	...	0·925	...
Volumes of distillate obtained by distilling 100 parts at a temp. of 212° F.										
at 266° F.	5	...	...	...	6	...	9	...	15	...
at 302° F.	5	...	...	...	7	...	9	...	15	6
at 356° F.	19	...	...	...	36	...	35	...	35	21
at 365° F.	...	...	...	...	...	...	...	...	...	6
at 376° F.	...	...	...	...	15	...	12	...	12	4
at 379° F.	15	...	...	...	15	...	12	...	12	4
Total amount of distillate	47	...	...	...	79	...	77	...	77	31
Residue	50	...	...	...	93	...	93	...	93	34
Loss	3	...	...	...	4	...	...	...	...	3
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	12	...	...	...	12	...	7	...	6	4
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	15	...	6	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	35	...	21	6
	...	...	...	...	...	...	...	...	...	...

land. Their profits may be estimated, when it is considered that the lowest priced machine selling for $60 costs a little less than $12 to the manufacturer, and had not the holders of these patent rights been so protected by the government, the price of these necessary articles of household economy would have fallen to $20 or $25 long ago. It now turns out that several matters in connection with this have been "overlooked."

A short time ago a gentleman looking over the volumes of British patents in the Astor Library for an invention which he wished to trace came unexpectedly upon the identical sewing-machine claimed to have been invented by Howe. This may be found among the patents of the year 1790, number 1764, and was granted by His Majesty King George III, to Thomas Saint, of Greenhill's Rents, in the parish of Saint Sepulchre, county of Middlesex, England, and is described in the specifications accompanying the drawings as "a machine for stitching, quilting, and sewing," with the following explanation, showing that it is identical with the modern sewing-machine. "A, B, C, is the frame, figure 1 is the reel for the thread, figure 2 is a spindle, which, moving to the right conveys the thread to the needle at 4, and moving to the left again takes hold of the stitch and keeps it tight till the needle has brought another stitch through the last taken, and so it goes on alternately till the whole article is completely stitched." Then follows a long description of the machinery by which the motion is gained, which is in all respects the same as the sewing-machine of to-day. The drawing shows that the machine had all the essential elements of the present ones. There is the horizontal table support, about the same height that the Singer machine has; it has a perpendicular oscillating needle bar, with an eye-pointed straight needle; it has s perfect horizontal automatic feed, for spacing the stitches; it has an upper tension and a "take up," to tighten the stitch; with the spool of thread on top of the arm, as most of the machines now in use have. The patent rights are now all held by what is known as the "combination," that is by the Singer, the Grover & Baker, and the Wheeler & Wilson companies. What is called the Bachelor extension was passed by Congress at the end of the session before the last. Poor Thomas Saint, the original inventor of the sewing-machine, seems to have followed the profession of a cabinet maker, and probably died in poverty, little dreaming that the product of his brain would take root in a new world and grew into a monster monopoly.—*N. Y. World.*

The Coals of the Kanawha Valley, West Virginia.

By JOHN J. STEPHENSON, PH. D.*

Along the Great Kanawha river the Upper Coal Group is observable up to about twelve miles below Charleston. It contains two coal beds of workable thickness. The lower one is the Pittsburgh (VIII of Ohio section) and is usually known as the "Raymond seam." It is much reduced in thickness where it crosses Potalico Creek and is very inferior in quality to the same bed in its nothern extension. The limestone overlying this coal in Northern Ohio and Pennsylvania as well as in the northern part of West Virginia, is here greatly degraded, being represented by only a calcareous shale containing a few nodules of limestone. The upper bed of coal is occasionally of workable thickness, but is of no economical importance. When the section has been completed, this coal will probably be proved identical with the one given in Dr. Hildreth's section at Pomeroy, which is No. X of the Ohio section, and likely the equivalent of the Uniontown coal of Pennsylvania.

The Barren Group reaches to Charleston and runs out in the hills a short distance above the city. It is about five hundred feet thick and contains, as far as I am informed, no workable coals. It is interesting to note that along a rudely constructed north and south line, beginning at Pittsburgh and running to the Great Kanawha, the Barren Group varies but little in thickness.

The Lower Coal Group sinks under the river a short distance below Charleston. Its development here, as compared with that observed in the coal field farther to the north, is extraordinary. In northern West Virginia the thickness is barely two hundred feet; in the First Geological District of Ohio, it rarely exceeds three hundred feet, while in either case it only contains only six or seven coal beds. In this valley it is readily separable into two portions, the upper of which is exposed along the river from Charleston to the Falls, a distance of thirty-five miles. Including the Mahoning sandstone, it is not less than nine hundred feet thick, and contains at least fifteen beds of coal, each of which is of workable thickness at different localities. The lower division is exposed above the Falls to Sewell Mountains, a distance of certainly thirty miles in a straight line. It contains only two or three beds of coal that are anywhere of workable size and is made up chiefly of massive sandstones, with rarely a thin shale of limestone. The estimation of its thickness is attended with some difficulty, as the dip is undulating, and there may be one or two broad anticlinals. There is no reason to believe, however, that it is any thinner than the upper division. We have here, then, a total thickness of not less than eighteen hundred feet, with about twenty coal seams, most of them workable at some point. The extraordinary development of this group continues southwesterly, until its thickness becomes about twenty-five hundred feet in Tennessee. A careful survey of the State of West Virginia would doubtless reveal some very important facts in this connection, and would aid in solving some perplexing problems arising from this variation.

The Mahoning sandstone is conspicuous in the river hills above Charleston, and, as in its northern extension in this State and Pennsylvania, holds about midway a coal which frequently becomes of available thickness. It rests upon a variable bed of black flint, five to twelve feet thick, which is occasionally associated with a thin seam of cannel.

A few feet below the flint, and separated from it by shale, often arenaceous, is a coal partly cannel and partly bituminous At Cannelton it is five feet four inches thick, and on Paint Creek, near Coalburg, it is seven feet. This is usually regarded as identical with the Upper Freeport of Pennsylvania (VI of Ohio). Aside from its position, one finds in its deportment evidence of this identity, since, wherever I have observed it in West Virginia, it shows a decided tendency to become partly cannel. Though I have not visited Peytona, yet an examination of the map, and the fact that Coal river heads near that locality and so cannot have cut very deeply into the country, seem to render it probable that this coal, known locally as the "Stockton seam," is the same with the cannel there worked. It seems hardly possible that the "Gas coal," situated five hundred and fifty feet below the "Stockton" at Cannelton, can be available at Peytona.

AtCannelton a five feet coal is seen a few feet below the last, but at Coalburg it is absent, or is represensed by two small seams occupying about the same relative position. Mr. Ridgway identifies this with the Lower Freeport of Pennsylvania. That is an exceedingly variable bed and cannot be traced satisfactorily in southwestern Pennsylvania or northern West Virginia. The whole of the state lying between the Baltimore Railroad and the Great Kanawha River, is as yet unexplored. Under such circumstances it is doubtful whether one is justified in making the determination solely upon the ground of relative position, this being, at best, an unsafe guide.

At Cannelton, the second seam below the "Stockton," is a cannel of insignificant thickness. At Coalburg, however, this place is occupied by the "Great Splint Coal," which in some respects is the most important bed along the river, although its importance is probably local. At the Kanawha Salines no such bed appears, but where it should be, there occur several thin beds considerably separated. On Paint and Cabin Creeks its thickness is not far from eleven feet and on Campbell's Creek, if Mr. Ridgway's identification be accurate, it is six feet. At Coalburg it has been worked extensively for several years by the Kanawha and Ohio Company, under the superintendence of Mr. W. H. Edwards, so favorably known to the scientific world by means of his beautiful work on the Butterflies of North America. At the mines of this company the bed exhibits the followinfi section:

1.	Sandstone.....	
2.	Clay shale.....	1 inch
3.	Coal.....	6 inches
4.	Dark slate.....	4-7 inches
5.	Coal.....	3 ft. 2 ins.
6.	Clay.....	3 ft. 5 ins.
7.	Coal.....	1 ft. 6 ins.

The roof is very irregular. Not unfrequently a huge clay "hip" comes down two or three feet, crossing the entries in a rudely northeast and southwest direction, and having a width of from five to twenty feet. Such "hips" are not always of clay but are sometimes an odd mixture of sandstone and coal, the latter included not as layers, but as fragments, as if it had been cut out after consolidation, though in several instances the bowl-shape of these fragments leads to the belief that it may have been removed before consolidation. These "hips," when traced across different entries, are seen to taper off at each end.

The thin layer of clay ord narily interposing between the sandstone and coal contains numerous impressions of *Lepidodendron* and *Sigillaria*, but usually in poor preservation. Some years ago a series of remarkably fine leaf-scars of *Bothrodendron* were found in entry I of the company's works. Of these, several were sent to the Smithsonian Institute and to Mr. Lesquereux. The rest were retained by Mr. Edwards, but were lost during the destruction of his house by fire, a year ago.

The dark slate, No. 4, is rich in bitumen, breaks with a semi-conchoidal fracture, but does not burn readily and is regarded as detrimental to the coal. The coal, No. 5 is the most important portion of the seam, and with No. 3, affords the marketable coal, which is sold in Cincinnati as Kanawha semi cannel. When first shipped the proprietors named it "splint," simply to distinguish it, and without reference to the British sifinification of the term. This name was afterward applied to all the open-burning coals of the Kanawha Valley. The coal is clean, breaks with a neat, sharp fracture, bears transportation well and contains no appreciable quantity of sulphur. It is made up of thin alternating layers of cannel and bituminous coal, for the most part not more than one-twelfth of an inch thick, though occesionally a layer of cannel occurs of one or two inches. It is consequently dry and open-burning, with no tendency to cake upon the fire. The "slack" yields a coke of only slight density. Owing to the open-burning character, as well as to the freedom from sulphur, this coal is destined to become of very great economical importance. Experiments have been made with it in the iron furnaces of southeastern Ohio, and in each case it has proved to be of the best quality. Owing to the uncertain outlet afforded by the Kanawha River, little has been done with this coal, but now that the Chesapeake and Ohio Railroad has been completed, the operators in the Kanawha Valley will be able to forward a steady supply, so that its introduction into southeastern Ohio for use in iron smelting is a matter of comparatively short time.

No. 7 is variable in thickness and contains more bituminous coal than the preceding. It is of excellent quality but is too brittle to bear transportation. The larger proportion of biteminous matter led to the belief that it could be coked, but experiments in this direction have not been successful.

The clay parting, No. 6, is of uncertain thickness. At the mines of the Kanawha and Ohio Company, it is seldom more than 4 inches, but followed westward it rapidly increases, so that at the western boundary of the company's property it is two feet. A similar increase, though by no means so great, is observable in the upper parting, so that, as far as one may judge with the imperfect exposures presented, there is much reason to believe that the thin coals at Kanawha Salines, occupying the position of this bed, are nothing other than its subordinate coals, 3, 5, and 7, separated by the partings, 4 and 6, greatly increased in thickness.

About forty feet below this coal is found a seam of cannel, nearly three feet thick, well exposed at Cannelton, Paint Creek, and on both sides of the river at Coalburg. It is of good quality and will probably prove of much value.

Five hundred and fifty feet below the "Stockton" coal at Cannelton, there is a bed of bituminous coal nearly seven feet thick and known as the "Gas coal." This is seen at Coalburg and has been worked opposite that village on the northeast bank of the river. Its thickness there is inconsiderable, barely three feet, and its quality is poor. At Cannelton Mr. Ridgway observed a limestone below this coal, which he identifies with the *Ferriferous* of Penn'a. This is not exposed at or opposite Coalburg and I did not observe it at Cannelton. If Mr. Ridgway be accurate in his determination of the limestone, the "Gas coal" is very

* Read before the Lyceum of Natural History, Feb. '73.

probably the Kittanning of Pennsylvania (No. IV of the Ohio section). In this case the persistent seam a short distance below the limestone is the equivalent of the Ohio No. III.

The coal below these belong to the lower division of the group, which I had no opportunity to examine. They are said to be well exposed in the gorge of New River.

The dip of the strata below the Falls of Kanawha to Charleston, is somewhat less than 30', but below Charleston they are horizontal, or at least the dip is inappreciable. Above the Falls it is very undulating and one may expect to find one or more broad anticlinals between the Falls and Big Sewell Mountain.

Lens Fires.

Dr. H. C. Bolton, of Columbia College, New York City states that on a recent occasion, at 9 A. M., on entering his laboratory he found a wooden table on fire, ignition having been occasioned by the rays of the morning sun, which fell upon a glass spherical flask containing water. The flask served as a lens which concentrated the rays and set fire to the wood. The author also alludes to the statement of Lactantius (A. D. 300) who mentions the use of glass globes filled with water, to be used in kindling fires; while Pliny recommends the use of lenses for the purpose of cauterizing the flesh of sick persons. As to the latter, one Mr. Barnes of Connecticut, took a patent in this country some five years ago for the use of lenses for the purpose suggested by Pliny.

In respect to fires occasioned by lenses, doubtless there are many examples. It is well known that vessels at sea have been set on fire by the bullseye glasses used to admit light to between decks. These glasses were formerly made convex on one side, thus forming powerful lenses. In consequence of the loss of property and danger their use has been discontinued, and thick plates of glass, flat on both sides, have been generally substituted.

Captain Scoresby and Dr Kane used to astonish the natives of the polar regions by taking blocks of clear ice and cutting them into the form of lenses with which they instantly kindled fires.

Society of Arts Special Prizes.

The Council of the Society of Arts, ever ready to stimulate inventors, by the offer of gold medals and money prizes, are again coming forward with a long list of desiderata for the next three years, from which we select, as most genuine to our own objects, those having some relation to coal and iron.

The Council has had £500 placed at its disposal for the purpose of encouraging economy in fuel, whether by the use of improved grates, or means of utilising waste coal, or the production of a substitute for coal. The Society's gold medal and £50 is therefore offered in each of the following cases:

1st. For a new and improved system of grate, suitable to existing chimneys, which shall, with the least amount of coal best answer for warming and ventilating a room.

2d. A new grate, under similar conditions, which shall, with the least amount of coal, best answer for cooking, combined with warming and ventilating a room.

3 and 4. For the best new and improved system of apparatus which shall, by means of gas, perform the offices of grates, Nos. 1 and 2 respectively, and

5. For any new and improved system or arrangement, not included in the foregoing, which shall efficiently and economically meet domestic requirements.

Prizes are also offered for a more economical method than any at present in use of preparing waste coal, so as to render it available as a substitute for coal, of fuel manufactured from peat, and suitable for combustion in domestic fire-places, the furnaces of steam-engines, and for industrial purposes generally. Improvements in the methods of getting coal, ventilating and lighting mines, tunnelling, etc., are also included in the list of achievements deserving of recognition by prizes, which, with many others, may be found in the list issued by the Society.—*Iron.*

Note on the Synthesis of Marsh-Gas and Formic Acid, and on the Electric Decomposition of Carbonic Oxide.*

By Sir B. C. Brodie, Bart., D.C.L., F.R.S.

Late Waynflete Professor of Chemistry in the University of Oxford.

In connection with the investigation on the electric decomposition of carbonic acid gas referred to in a previous communication to the Society, I was led to submit a mixture of hydrogen and carbonic oxide gas to the action of electricity in the induction tube, the mixed gases being circulated through the tube by means of an apparatus which I will not now describe. A contraction was soon observed to have taken place, which at the end of an hour amounted to 10 c.c. The rate of contraction steadily diminished, and during the fifth hour of the duration of the experiment amounted to only 2 c.c. The experiment was stopped, and the gas analysed with the following results in two several analyses:

I.		II.	
Carbonic oxide	61·60	Carbonic oxide	61.43
Hydrogen	32·16	Hydrogen	32.34
Marsh gas	6·24	Marsh gas	6.23
	100·00		100·00

A small quantity (about two per cent.) of nitrogen was also contained in the gas, together with a trace of oxygen, which have been omitted from the calculation.

The result of this reaction is expressed in the following equation:

$$2CO + 7H = C^2H^3 + 2HO.$$

This fundamental experiment, which constitutes the basis of a new method of chemical synthesis, susceptible of the most varied applications, and of peculiar interest in reference to the explication of natural phenomena, was commenced by me on the 10th of January last, at Oxford, in the laboratory of my friend and successor in the Chair of Chemistry, Prof. Odling; and two analyses of the gas were completed, and the results attained in the course of a week from that date.

In a similar experiment made with a mixture of hydrogen and carbonic acid gas, a contraction also occurred, attended with the formation of water. The gas resulted from the experiment was found to consist (after the absorption of carbonic acid) of hydrogen and carbonic oxide, together with a little marsh-gas. Traces of oxygen and nitrogen were also present. Minute drops, too, of an oily liquid appeared in the tube. This liquid, after the conclusion of the experiment, was dissolved in a small quantity of water. The solution was strongly acid and had a pungent taste. It reduced an alkaline solution of terchloride of gold and an ammoniacal solution of nitrate of silver. These reactions are the characteristic properties of formic acid, of which we may infer the synthesis to have been effected according to the equation:

$$2H + 2CO^2 = C^2H^2O^4.$$

I may avail myself of the present opportunity to place on record the following important facts in reference to the action of electricity on carbonic oxide gas.

When pure and dry carbonic oxide is circulated through the induction-tube, and there submitted to the action of electricity, a decomposition of the gas occurs, attended with a gradual and regular contraction, which in the form assumed in my experiments, occurred at the regular rate of about 5 c.c. in an hour. Carbonic acid is formed, and simultaneously with its formation a solid deposit may be observed in the induction tube. This deposit appears as a transparent film of a red-brown color, lining the walls of the tube. It is perfectly soluble in water, which is strongly colored by it. The solution has an intensely acid reaction.

The solid deposit in the tube, in the dry condition before it has been in contact with the water, is an oxide of carbon. Samples, however, made in different experiments do not precisely present the same composition; but nevertheless they appear to belong to a certain limited number of forms which repeatedly occur, and may invariably be referred to the same general order or system. This system is, or appears to be, what I may term an homologous series of "oxycarbons," of which the unit of carbon with the weight 12 may be regarded as the first term, and of which the adjacent terms differ by an increment of carbonic oxide (CO) weighing 14, precisely as homologous series of hydrocarbons differ by the increment C_2H_2 with the weight 14. I have succeeded in identifying by analysis two at least of these substances, namely, the adjacent terms C_4O_3 and C_5O_4. From this point of view these peculiar bodies are members of a series of oxycarbons analogous in the oxycarbon system to the series of hydrocarbons of which the unit of carbon (C^2) is the first and the unit of acetylene, C_4H_2, is the second term, the oxycarbon C_4O_3 being represented in that series by the hydrocarbon crotonylene, C_4H_3 and the oxycarbon C_5O_4 by the hydrocarbon valerylene, C_5H_4.

* Read before the Royal Society, April 5.

On the Measurement of Very High Tsmperatures.

The measurement of the temperature in glass furnaces, brick and porcelain kilns, blast furnaces, and the like, presents more or less difficulty, and various pyrometers have been invented for this purpose. The mercury thermometer has been employed for temperatures under 450° C., by filling the tube above the column of mercury with air under four atmospheres of pressure, but cannot be used above that. The Wedgwood pyrometer, so-called from its inventor, depends upon the *contraction* of clay when heated. Aside from this, there are, according to Weinhold, ten different methods of measuring changes of temperature, depending upon the following phenomena:

1. Expansion of bodies.
2. Change of pressure in confined gases (as the air thermometer.)
3. Calorimetric; warming cold masses.
4. Melting of solid bodies.
5. Conduction and radiation of heat.
6. Change in the velocity of sound (acoustic pyrometer.)
7. Optical phenomena.
8. Dissociation of chemical compounds.
9. Generating electricty (thermo-electric pyrometers.)
10. Change in its resistance to electricity.

In the first class, Weinhold found that Bock's pyrometer varied too greatly from the true temperature, as shown by an air thermometer, but Oechsel's spiral pyrometer was much more correct.

The gas or air thermometer belonging to the second class, is the only reliable standard for fundamental experiments, but, unfortunately, it is impracticable to employ it for most purposes, and it can only be used to control other pyrometers.

The calorimetric processes, class three, in which the temperature is oscertained by the quantity of heat which a heated body gives up to a larger quantity of some liquid, is too complicated for technical use, on account of the precautions and corrections that it requires.

In reference to the fourth method, the use of alloys of tin and copper, whose melting points are known there seems to be little objection, except their inconvenience.

The fifth method does not give satisfactory results.

Two Frenchman, named Cagniard-Latour and Demonferrand, have employed the change of pitch in the tone of a flute for calculating the temperature.

In class seven, under optical phenomena, come red and white heat, and the play of colors upon steel, as indicating approximate temperatures, and which are in general use. But they are not reliable as measurers of heat.

The eighth method, which depends on dissociation, was invented by Lamy, but Weinhold doubts its practicability at present. The latter author also report

unfavorably upon the ninth or thermo-electric method for high temperatures.

The only reliable pyrometer, then, which can be recommended for practical purposes, is one based upon the change of resistance offered to a galvanic current by metals at different temperatures. Such a pyrometer consists of a six cell battery, charger, differential voltameter, and two resistance coils. One of these is made of German silver, which remains at the ordinary temperature, the other of platinum wire and is exposed to the temperature to be measured. By observing the change in resistance for certain changes of temperature, a formula has been prepared, and tables prepared, for converting one directly into the other. These pyrometers are known in Europe as the Siemens' pyrometer.—*Hanover Wochenblatt, fur Handel und Gewerbe.*

Cooking by Gas and Petroleum.

[We condense from a report on the Exhibition of the Society of Arts.]

The original form of gas stove, a ring of gas pipe pierced with a number of holes, unprotected by any heat-preserving arrangement, although a very simple and cheap apparatus, is as extravagant a form of cooking stove as could be imagined, though it has this special advantage, that the gas is always ready at any moment, where there is day service, and the fire can be extinguished the moment the cooking is done. Its disadvantages were many, the holes in the pipes wore away rapidly, and the jet thus became irregular; every breath of air caused flickering and loss of heat, and the product of combustion often filled the place with disagreeable smells, while the meat in broiling was liable to be contaminated with them.

One of the grand faults of the original gas stoves was corrected by the introduction of the atmospheric jet, or Bunsen burner, which consists simply of a gas pipe placed within a pipe of larger dimensions, and fitted with holes to admit air; the pressure of the gas causes the air to enter the outer tube at a proportionate rate, and the gas and air are then burnt together in the proportion which the inlets of the two bear to each other. The effects of this arrangement are great economy in the amount of gas consumed, small steadily burning jets, with great heating and but little luminous power, and lastly, the absence of sooty deposit on the cooking utensils, in consequence of the more perfect combustion caused by the oxygen of the air. A gas cooking apparatus without an atmospheric burner, ought to be regarded as a monstrosity, only equalled by the burning of a candle in the open air without protection. But even with the use of the Bunsen burner, the ordinary gas stove is a wasteful apparatus, and the amount of heat lost is out of all proportion to the work done by its means. Fortunately this fact has been recognized, and the most approved gas apparatus presents many arrangements well deserving of attention.

First in order, as in importance, is the show of gas apparatus made by Messrs. Leoni & Co., of London (4,705). In the collection exhibited by this firm is almost every form of cooking apparatus, from the simple ring of gas to that for the preparation of food for a large household, and even for public establishments. Mr. Leoni has evidently studied his subject carefully, and has produced admirable results.

In the first place he has adapted a patented composition, called "adamas," to the formation of gas-burners. These are placed in holes in the gas rings and tubes, and, while they produce well-formed jets, wear infinitely less than the holes in an iron pipe, which soon lose their regularity of form from the heat. Secondly, he has introduced a fireproof material in many ingenious ways, as linings to large cooking apparatus, as reflectors and diffusers, and as small ovens, and has thus given to gas apparatus new and improved forms. The simplest form of cooking-stove, as supplied by all makers of such apparatus, is a ring of gas jets set within an iron frame, which serves as support for kettle, sancepan, and fryingpan. The next step is the adoption of the principal of reflection. In this case a boiler, with stewpan and steamer, is placed over the gas, while a portion of the heat reflected by the bottom of the boiler is made to grill a chop below. In place of the boiler a pair of Mr. Leoni's heat reflectors may be used. These are simple circular vessels, made, as already stated, of fireproof ware two or more inches deep, and about half-an-inch in thickness. Two of these placed together, the upper one bottom upwards, form an excellent oven for potatoes or any small pieces of meat, etc., and the heat on the top is sufficient for gentle simmering, or keeping anything hot.

The complete application of the principles of reflection, diffusion, etc, is well illustrated in an apparatus three feet high, and about sixteen inches in diameter, capable of roasting a joint of meat up to 14 lbs., baking four loaves of bread, or cooking an entire dinner. A description of the parts of this apparatus will explain the principles adopted by Mr. Leoni. The ring of gas is near the bottom of the apparatus, above the dripping-pan; on one side is the gas-pipe connection, and in the other a neat arrangement for lighting and extinguishing the gas. The outer case of the stove is of iron plate, but within this is a jacket of heat reflecting composition, an inch thick. Between the iron case and the composition lining is a space all round, which greatly economises the heat, and allows of complete ventilation when required. The top of the stove is simply covered by one of the heat reflectors already mentioned, on which anything may be kept hot, or which may be replaced by a gas ring for broiling. The interior of the stove may be arranged according to the requirements of the day, being built up of circular stands made of thin iron-plate. At the bottom of one stand is a heat-diffuser—a mere circular plate of the fire-clay composition; this is used to disseminate the heat equally, and is necessary in all cases except roasting, when a fierce central heat answers best. When a large piece of meat or poultry is to be roasted, it is simply hung from the centre of the frame, the divisions being removed.

The above description will apply generally to nearly the whole of the cooking stoves made by Mr. Leoni, whether large or small, round or square. For hotels and other large establishments Mr. Leoni makes roasting apparatus to cook from 100 to 300 lbs. of meat or poultry at once. In these cases the cover is lifted by means of a lever, the body of the machine is drawn from beneath on rails, and the iron cage of two stages containing the meat lifted out by means of a light crane. The principle has been still further carried out by the same firm at the London Hospital, in the Whitechapel-road, where a large apparatus has been at work for a considerable time. This stove is, for convenience, fitted beneath the floor line; the roof or reflector of the apparatus is attached to an iron trap-door, which fills up the opening, and thus completes the level of the floor. By means of cogged wheels, the winding up or down of this trap is easily done in two or three minutes: a light crane by a similar process works up and down an iron lift which holds the meat, and in this manner eight minutes are sufficient time for one man to fill the apparatus with about 300 lbs. of meat, and the same time to empty it. The dripping is carried off as soon as produced, into a pail at some distance from the gas apparatus, where it cools at once; products, fumes, steam, etc., are carried off underground into the flue; gas is lit, turned on or off by means of a special apparatus, from the floor above ground, and according to the quantity of meat the heat is regulated, by turning on either one, two, or more supplies. The whole quantity of meat is roasted in exactly two hours' time. During the roasting the meat requires no basting, turning, or any attention whatever.

This apparatus was set up in 1870, and its results are thus summed up in a letter by Mr. J. Nixon, house-governor and secretary of the hospital: "In the six months ended 31st December last (1870), the large roaster was in use 125 days, being about six days short of a full half year's work. The waste of meat during this period averaged about 14½ per cent., as against 33⅓ under the old systems of roasting, while the consumption of gas was also reduced from a daily average of 610 to 250 cubic feet. The actual saving to the hospital in 125 days was, in meat, 4,579 lbs., and in gas 14,525 cubic feet, or for a full year's working of 261 roasting days very nearly 10,000 lbs. of meat, worth at present prices £296, and about 88,000 cubic feet of gas, costing $17 12s,, and representing together an annual saving in money of £313 12s."

"Breakfast for five adults and three children—two pints of coffee, one pint of tea, half pound of bacon, half-pound of oatmeal for porridge, six rounds of toast; time, twenty minutes; consumption of gas, twelve feet; cost, under three farthings. Dinner for twelve adults and three childfen—6 lbs. leg of lamb (loss, 1¼ lb.), 4 lbs. sirloin of beef (loss, 10 oz.), 5 lbs. of potatoes, six large cauliflowers, two large fruit pies; time, 1¾ hour; consumption of gas, 48 feet; cost, 2¼d."

Messrs. Leoni have also applied gas to the production of steam and baking. They exhibit a high-pressure steam boiler, worked with 36 gas jets, which produces 100 feet of steam per hour, with a pressure of 10 to 15 pounds per inch. A pipe connects this boiler with a steam cooking chest, having a metallic lining throughout, cover included, the space between the metal casing and the wood lining filled, like the Norwegian boxes, with felt.

Messrs. Billing & Co., of London (4,714) have in their stoves, which are good specimens of work, relied almost entirely on the principle of reflection for the operation of roasting. The mode adopted is one which has been in use for some years for gas-heating stoves, and originated, we believe, in France. The gas pipe is above the meat to be roasted, and thus all fear of the latter deriving any unpleasant smell from the process of combustion of the gas is entirely obviated. In small apparatus the heat is reflected downwards direct upon the meat, while in larger stoves the reflector is placed at an angle of about 45° behind the meat, and a tin reflector placed in front of the joint, as in the case of an ordinary coal fire. Above the gas is the hot plate, and thus one series of jets is made to perform two sets of operations, as in the small gas cooker described above; this looks, at first sight like a very economical arrangement, and so, under certain conditions, it is. If a good deal of cooking is to be done at the top of the stove, and a small amount below, the economic conditions are fulfilled, but if these be reversed there must be a great loss of heat, for a given number of feet of gas can only give a certain number of degrees of caloric; and, moreover, the reflected heat is not equal to direct heat. The roast below the gas must require a large quantity, and, as already stated, unless the top heat is actually required, there must be loss. A chop, or any small article cooks admirably under reflected heat, but the system can only be regarded as supplementary.

Messrs. Billings have adopted the good arrangement of double sides to their ovens, and thus obtain great regularity and economy of heat, but the latter would be much increased by the addition of fire-clay linings. The almost unavoidable spilling which occurs in cooking causes extremely unpleasant vapors to arise; this is in some cases partially prevented by the use of sand on the hot plate, and Messrs. Billings have adopted an ingenious mode of cleaning the plates; in small stoves the top rails or other supports for the sancepans, lift up to allow of the plate below being cleaned, and in the large stoves this plate is made to draw out, like the wooden tray of a bird cage. Messrs. Billings make use of the Bunsen burner in various sizes, and their pipes and fittings are well arranged. The following is their own statement of the capabilities of one of their family cooking stoves, about three feet high by 18 inches square: "A joint weighing nine pounds, a large family pie, a couple of ducks, two kinds of vegetables, fish and soup, were all cooked at one time in the space of two hours, consuming about 10 feet of gas."

Messrs. John Wright & Co., of Birmingham (4,735), are well known manufacturers of gas cooking and other stoves, and the articles which they exhibit are neatly got up, in some cases remarkably so; the white tiles, set in neat iron frames, present a bright and extremely clean appearance. Their ovens and general apparatus for cooking bread, meat, and all other kinds of food, have, we are informed, been for some time in use at the Crystal Palace, Sydenham, and many other establishments. These makers do not seem to adopt either double iron walls or fire-clay linings, and this must be regarded as a serious oversight; the escape of heat which has done no cooking, must always be one of the tests of the economy or otherwise of such apparatus, and their white tiles, although good reflectors, are very far indeed from perfect reflectors and anti radiators. Messrs. Wright, however, make use of certain earthen reflectors and heat distributors, similar, if not identical, with those of Messrs. Leoni. They declare that their ordinary domestic cooking stoves do not consume more than a pennyworth of gas per hour.

Gas stoves are also exhibited by Messrs. Davis and Son, of Westminster; Mr. Hall, of Battersea; Mr. Mitchel, Mr. Southby, and Messrs. Chavasse & Co., of London; Messrs, Scott and Butler, of Birmingham; Messrs. Verity Brothers, of Paddington, and one or two other firms, but present no features calling for special notice. The last-named firm makes

use of large fire-clay burners, and white porcelain slabs beneath the hot-plate.

A word should be said by way of recommendation of the excellent French fire-proof dishes and pans introduced by more than one exhibitor of gas apparatus.

Cooking by means of petroleum or other hydrocarbons is illustrated by two exhibits, that of Messrs. Oldhner and Co., of Stockholm (4,707), which is a small portable apparatus, with two lamps, with long, flat wicks; and the apparatus of Messrs. Randall and Co. (4,730), who apply the vaporization of hydrocarbons to large and small cooking apparatus as well as to heating purposes. These "vapor stoves," as they are called, are but recently introduced, and require a few words of explanation The fire-place in which the mineral oil is burnt is circular, having in the centre a small hollow iron cone truncated, a taper ring. Behind the stove a small vessel containing the oil is mounted on a tall tube, so as to be out of the way of danger from the fire; and from the upright tube a small horizontal one passes over the top of the conical ring already mentianed; the supply being regulated by a stop-cock, the oil is allowed to drop very slowly from the tube into the ring. The oil being lighted burns at first in yellow flames, but when the dome and fire-place have become hot, which they soon do, the oil is vaporized at once, and burns in the form of gas with a blue flame. The apparatus seems to answer its intended purpose well, but its economy must be ascertained by practical experiment. The invention is American.

Crystal Palace District Gas Company.

We owe the following to the kindness of Magnus Ohren, Esq.:

DIRECTORS' REPORT OF THE CRYSTAL PALACE DISTRICT GAS COMPANY FOR THE HALF YEAR ENDING THE 30TH JUNE, 1873.

The directors have to report that the business and progress of the company have been satisfactory during the half year.

The price of coal, iron, labor, and all materials connected with the manufacture of gas, have maintained their largely advanced prices: but, on the other hand, much higher prices have been obtained for the residual products.

Up to the present time the directors have not found it necessary to increase the price of gas to the general consumers. The report of the Chemical Adviser of the company, Dr. Letheby, have given for the average result of his examinations the illuminating power of 14·99 standard sperm candles.

The balance-sheet for the half-year, to the 30th June last, shows the financial position of the company. The profit for the half year is £7,361 1s. 1d., which, together with £2,738 15s. 4d., the unappropriated profit of the preceding half year, makes the available balance £10,099 16s. 5d. Out of this sum the directors recommend the declaration of a dividend at the rate of six per cent. per annum on the Preference Capital: a dividend at the rate of seven per cent. per annum on the Ordinary seven per cent. capital: and a dividend at the rate of ten per annum on the Original Capital; all free of income tax: and that the balance of £3,041 be carried forward to the profit of the succeeding half year. By order of the Board.

ERASMUS WILSON, Chairman.

The Coal Committee.

At a meeting of the Select Committee of the House of Commons in June, Mr. Isaac Lowthian Bell, the president of the Iron and Steel Institute, was under examination for the entire sitting. He stated that he was largely connected with the iron works and coal mines on the Tyne, and in the counties of Durham and York. The idea that the rise in the price of coal was due to any combination of masters and men was, in his opinion, utterly absurd. He considered it was due to increased demand on producers, and a notable falling off in the supply. There used to be great waste, and reliance was placed on the coal in stock; whereas the coal owners were now thrown on the unworked coal. Anterior to 1850, the quantity of pig-iron produced in the north of England was 110,000 tons, and the total consumption of coal for iron purposes was under half-a-million tons a year; and in 1872 there were 1,958,972 tons of iron produced. The number of puddling furnaces had increased from 250 in 1850 to 1650 in 1872. Many of the coal-owners suffered when the rise of coal took place, because they had already entered into contracts for coal and coke at a fixed price per ton for three years. So great was the demand for coal that they, during the late pressure, brought coals from South Wales to Newcastle. There had been a falling off in the quantity of coal carried on the North Eastern Railway (of which he was a director) of half-a million tons between 1871 and 1872, and they looked likely to have a falling-off in 1373, as compared with 1872, of nearly a million tons. In one of his own collieries, hewers used to work twelve hours a day for 4s. 7½d., and would get 4¼ tons each per day; now the same hewers could earn 7s. 4d. per day of 9½ hours, and reducing the outfall to 3¼ tons per day. His firm were opening fresh pits for the supply of themselves and the market; and others were doing the same, and that was how the quantity was kept up. To raise artificially the price of coal, would require a combination of the whole of the masters of the United Kingdom who met in the London markets, and that, of course was hopeless. He had endeavored to get additional labor for the mines, but that meant building small towns at a price three times as much as it used to be. Many of the bar iron works in the North of England were being discontinued on account of the high price of coke and pig iron. In his opinion the whole of the coal of the North of England would be required to smelt the whole of the iron, and that the coalfields would be exhausted much sooner than the ironstone. Witness spoke of the economy of fuel in the manufacture of iron, a subject he went fully into in his address before the Iron and Steel Institute, published in these columns. He did not believe that the exhaustion of coal was so dangerously near as Sir William Armstrong had a few weeks ago. The excess of demand for coal over supply in his own district was about 600,000 tons. An export duty on coal was not desirable. They were raising coal all over Europe as cheaply as we were doing it, but the whole quantity would not suffice to keep the English ironworks going. There was nothing to fear from foreign competition on the use of coal for the manufacture of iron. In America, notwithstanding the dearness and irregularity of labor, the increase in the manufacture of pig-iron since 1871 was 18 per cent.; but still it was a fact that America afforded the largest market for English iron. —*Iron.*

Petroleum in Roumania.

By J. LEWIS FARLEY, OTTOMON CONSUL AT BRISTOL.

The astounding results, both financial and material, which have accrued from the discovery of petroleum in the United States of America and in Canada, are too well known to need a recapitulation. Instead, however, of being confined, as was at first supposed, to a single district, it has been now demonstrated that petroleum exists in so large an area as to justify the belief that no country in the world is destitute of this valuable product. In America the trade has assumed gigantic proportions, the first export of this article was in May, 1860, when 10,000 gallons were sent to Antwerp. The total export in that year was 1,500,000 gallons, which in 1868 increased to 99,281,000 gallons, and in 1870 to 141,208,155 gallons.

In England, Germany, Italy, the islands of the Ottoman Archipelago, and Syria, earth oil has either been found in abundance or is known to exist; and, in all probability, it will be discovered in Russia, Persia, India, and China. But there is no country in the Old World which has been so plainly proved to be a land flowing with petroleum as the United Principalities of Roumania. Over the whole of the Carpathians it oozes through the soil, and pollutes the water springs. Associated capital has been brought to bear on its extraction and export; but, strange enough, the mechanical appliances by which success has been achieved in other countries, have only recently been introduced into Wallachia. Ignoring the experience of others, the Roumanian petroleum companies have been content to adopt the primitive mode of collection in use with the peasantry, by making excavations in the earth, into which the oil saturating the strata flows. By this means large quantities of petroleum have been obtained; but the continued necessity for making fresh holes of wells, with risk of the surrounding land turning out to be unproductive, not being conducive to profitable commercial working on a large scale, attention is now directed almost exclusively to deep boring, with every prospect of success.

The value of petroleum cannot well be over-estimated, as the demand for the article is constantly increasing, while the knowledge of its uses is daily extending. Burning-spirit and lubricating oil have heretofore been the principal products of distillation, but a new use seems likely to be found for crude petroleum as a steam fuel. In America it has supplanted coal in some manufacturing establishments, while the governments, both of the United States and Great Britain, have been experimenting, with the view of determining its relative superiority over coal in vessels of war. The results of the trials, with a specially-constructed furnace, and a porous vehicle for the oil, are said to be very satisfactory—one pound of oil evaporating 13 pounds of water, with a gain of something like 40 per cent. in the power of the engine.

The advantages claimed for petroleum, as a steam fuel, are cheapness as a generator, economy of space for storage, and greater simplicity in the arrangement of the furnace. It is needless to say that each of these propositions is combated by some scientific man on theoretical grounds; but, assuming that the experiments have proved as satisfactory as is stated, it does not necessarily follow that petroleum could supersede coal in a country where the latter mineral is plentiful, and the former article scarce. In a country like Turkey, however, where the coal measures are undeveloped, and steam fuel has to be imported, the value of a large supply of native petroleum is of the highest possible kind.

There are about seven thousand flour-mills in Roumania, only thirty of which are worked by steam, the remainder being worked by water, wind, horses, and oxen. There are also 1687 distilleries, 608 saw-mills, only a few of which are worked by steam; 72 breweries, 145 soap and candle manufactories, besides oil-mills, etc., most of which require power in the different manufacturing processes. To such a country the possession of an abundant supply of petroleum is obviously of the greatest importance, and the increase of wealth which would result from the substitution of steam for water and wind as motors in Roumania, would be difficult to calculate. The advantages claimed for water as a motor are, in most cases, more apparent than real. The stations are few where a steady supply of water can be relied upon during the whole year, undisturbed by either floods or droughts, and they are fewer still where an extraordinary run of water can be carried off without interfering with the driving machinery. If, therefore, the uncertainty of being able to work—through the operation of the two causes named—be considered, and the average expense of sustaining the banks of streams, and maintaining the walls of reservoirs and sluices, be taken into account, in comparison with cheap steam, which can be generated at will, there cannot be a doubt that steam, if judged by the necessities of modern trade, is the most economical of the two. The subject is not unworthy the attention of capitalists and engineers.—*Iron.*

Heating Railroad Cars.—A fire-proof stove for use in passenger cars especially, was subject to a severe test in Boston, recently. The stove is made of wrought and malleable iron. It is circular in form, composed of three upright cylinders and two cold air boxes at the bottom. The fuel is placed in the inner cylinder. The cold air rushing through the cold air boxes drives hot air outward and upward through the cylinders, the rounded force giving a very powerful radiation. The heat escapes through a register in the back. The whole is strongly bound together by strong iron bolts. The doors are fastened by patent locks. At the trial the stove, after the fire in it was well under way, was thrown from the staging upon which it was placed, to the ground, a distance of six feet. It was then rolled about, tumbled over and over, but not a spark of the fire was spilled upon the shavings which were scattered around. When the stove door was opened the fire was burning briskly. This ingenious apparatus was invented and manufactured in Wilmington, Del.—*Exchange.*

On the Use of Steel for Boilers.

From a late number of the *Deutsche Industrie Zeitung* we learn that Mr. R. L. Haswell, Engineer of the Austrian State Railway Company, spoke on this subject in the Society of Austrian Engineers. He remarked that the accidents which had occurred on railways using locomotive boilers of steel had thus far been only ascribed to the material: yet this was due, on the one hand, to the preparatory working of the plates, and on the other, to the small thickness, as well as to the insufficient mode of assorting them before they were used. The State Railway thus far has used about 50,000 hdw. steel plates, among which only 200 hdw. were thrown aside during the manufacture of the boilers.

Haswell only knows of five instances where such boilers got cracks, four of which occurred in the fire-box plate and one in the cylindrical part. Haswell ascribes their faulty condition to the fact that they were rolled when too warm. This shows that even by purchasing steel plates from the most renowned establishments and of the best quality, one cannot depend on their superiority for the purpose in question, without assorting them with the utmost care, because it can readily occur that in heating the plates one or more get spoiled. Hence, in the establishments of the State railway all plates are subjected to tests for their tensile strength, before they are used. That these tests are perfectly reliable is shown by the fact that of 350 boilers consisting of steel plate, only a single one was found torn thus far, and this in the cylindrical part. The box plates not having been tested, it is readily explained that four boilers were injured in those parts. But, although these plates had undoubtedly been impaired in their strength by overheating, they would probably not have been torn if the construction of the machines, namely, the boiler supports, did not involve an immense strength.

In order to obtain steel boilers answering all requirements, only correspondingly thick plates and plates of the best material, without any addition (for otherwise the steel is not homogeneous) ought to be used; they ought to be scrupulously assorted according to the texture and tensile strength After boring or punching they should be carefully annealed, the riveting must be performed with pedantic care, and the bending only with wooden hammers. That steel plates manufactured in Austria are of excellent quality, is proven by the manner how boilers are there constructed, the box front plate, down cover, and the sides of the tubes are only furnished with an edge or border, while in England they are compelled to use angle iron for these connections.

Steel plates are preferable to iron plates, owing to the fact that they possess the same degree of elasticity in all directions (from 12 to 15 per cent.); in iron plates it is in the direction of the fibres, and according to Kirkaldy, about 15 per cent., but in a cross direction only five per cent. If one proceeds in the manner indicated, says Haswell, steel plates may be used with perfect safety. The boiler manufacturer has the advantage that he finds less plates to throw aside, and the railways on the other hand will have more carefully constructed, stronger and, in the end, cheaper boilers,—*Iron.*

Disinfecting and Deodorizing Apparatus for Water-Closets.

An important improvement in water-closets, the invention of which consists of an apparatus for injecting into the pan of a water-closet a given quantity of any suitable disinfecting fluid, has just been patented in England. The apparatus, which consists of a cylinder of metal to contain disinfecting fluid, is placed under the seat of the closet. In this cylinder, and near the bottom, is fixed a small pump-barrel, fitted with an elastic or flexible plunger or bucket. To this pump-barrel, which is fixed to the bottom of the cylinder, is connected a small pipe, which extends to the top of the pan of the closet, and at a short pistance up the pipe is a valve. The rod of the pump is connected to the ordinary lever that works the plug for flushing the pan of the closet, the effect of which is as follows: Upon pulling up the plug the plunger of the pump will be raised and allow a small quantity of the disinfecting fluid to enter the pump-barrel, and upon the plug being forced down the plunger of the pump, will also descend, and force the disinfecting fluid that is beneath the plunger up the pipe leading from the pump to the pan of the closet, at the same time causing the pipe in the valve to open, and allow a certain quantity of the disinfecting fluid to be injected into the pan during the flushing, and while the water is in motion, thoroughly mixing and charging the flushing water with the disinfecting fluid. The pipe must be fully charged before it is ready for use. This may be done by working the plug up and down several times. —*Manufacturer and Builder.*

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

NOVEMBER 17, 1873.

DELIVERED IN NEW YORK.

English Cannel.			
Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00
English Caking Coals.			
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GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY
Publishing Office, No. 42 Pine Street.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

A. M. CALLENDER & CO.,
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EDITOR---PROF. HENRY WURTZ.
Editor's Private Office, 12 Hudson Terrace, Hoboken, N. J.
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MONDAY, NOVEMBER 17, 1873.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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GAS A NECESSITY.

Gas, like water, has become an important necessity in human life, and the chief object since its origin has been to advance its improvement and perfect it until at last we may exclaim "that we have drank draughts that common millions drink, then die because there is no more to drink." It is of great importance that gas as a light giving material should be improved to the utmost possible extent, so as to make it a perfect source of light.

Its conveniences are so patent to every one, its use is attended with so few discomforts, and the light is obtained with such facility, and of any desired intensity, within certain limits, that there is perhaps no source of artificial light equal to it. Wonderful improvements have been made within the past fifteen years, and still the inventive mind is constantly producing something new.

The superiority of coal in the manufacture of gas, over all other materials used in the production of artificial light, is acknowledged to be the greatest. And the general and persistent demand of the public for more gas, requires the erection of new works in our large cities, and most of our large towns, as will be observed by the number built within the past year. Small towns cannot be supplied with gas as cheaply as large ones, owing to cost of labor and apparatus, which will be much greater in proportion.

There is nothing in reference to gas light more important to gas consumers than the kind of burners used. The influence upon the surrounding atmosphere—the effect upon the eyes especially in writing or reading—the waste of gas when the main pressure is strong, causing increased gas bills, with a diminished quantity of light—all depends upon the proper combustion of the gas which passes through the burner. Patent burners, checked or stuffed with all sorts of things, such as screens, wire gauze, metal tubes, wool, sawdust, iron filings, etc., etc., have been placed before the public so often that the very name of "patent gas burner" has become a nuisance, because so many of them have proved of less value than a good plain burner, free from all incumbrances. Notwithstanding all this, there is a necessity of obtaining a bright light and a proper combustion of the gas, and whenever the pressure in the gas pipes exceeds five-tenths of an inch, there should be some restraint upon the passage of gas through the burner.

It is necessary that gas from the pipes should be *detained* at the tips of the burner long enough to imbibe sufficient oxygen from the atmosphere to produce perfect combustion, and when by extra pressure on the pipe, the gas is forced too rapidly through the burner, much of it escapes unconsumed.

Another advantage obtained is applicable in many circumstances, as a cheap and convenient substitute for coal as a fuel. It cannot compete with coal for ordinary cooking purposes, or for heating apartments, but when fire is required only for a short duration, the combustion of gas is much less costly and decidedly more convenient.

We find among other devices, that for giving to a gas stove the appearance of a cheerful, blazing coal fire, which but identifies the spirit of minor developments that attends this useful agent.

How long was it after the discovery of the production of gas from coal, before a manufacture could be found to bring it into actual operation? Forty years ago, working in his laboratory at Blansko, Reichenbach showed us the process by which we could obtain paraffine and paraffine oil from bituminous coal; but the discovery remained unheeded for twenty years. More than forty years ago Prof. Faraday pointed out a source of the electric light, in the permanent magnet, but we are only now beginning to use it for illuminating purposes. The man of science rejoices in the discovery of truth for its own sake. He gives its result freely to the world. It is no part of his duty, it is not his function to apply those truths to the utilities of life. Success in this direction demands quite different power of mind. Those who possess these powers ought also to acquire the necessary knowledge, which would enable them, with more facility, to seize upon the discovery of science, and apply them to the wants of every day life. This scientific knowledge is the link which, up to the present time, has so sadly failed in the application of science to the manufacturing art.

There is a deep, universal, and abiding interest existing throughout the Union, on the subject of gas light, the best mode of producing, and the most economical means of applying it to ordinary purposes, no one can question. Scarcely half a century has elapsed since its introduction into this country, and statistics will show how slowly it progressed for many years.

In 1816 it was imported from England into Baltimore, Md. Six years thereafter, in 1822, the City of Boston, Mass., ventured to risk the experiment of adopting it. New York city, not "usually behind the lighthouse," followed suit in the succeeding year, 1823. Two years afterwards, in 1825, the then little towns of Brooklyn, New York, and Bristol, Rhode Island, were lighted with gas. In 1830 the Manhattan Gas-Light Company shared the honors and profits with the New York Company by rescuing from "outer darkness" the district north of Grand street, in this city. Again, five years elapsed, and in 1835 the New Orleans, La., Gas Light Co. was established. In the following year Pittsburgh, Pa., exchanged her oil-lamps for gas. In 1838, Louisville, Ky., was illuminated. In 1841, Cincinnati, O., and Philadelphia, Pa., were gas-lighted for the first time. In 1844, Kensington, Pa. In 1845, Nantucket, Mass., although a fishing town, gave up whale oil for gas-light, and Albany, N. Y., followed her example. In 1846, Charleston, S. C.; Frankfort, Ky., and Newark, N. J. In 1848 Buffalo, N. Y.; Dayton, O.; New Haven, Ct.; Providence, R. I.; Reading, Pa.; Syracuse, N. Y.; Troy, N. Y.; Zanesville, O. In 1849, Chicago, Ill.; Detroit, Mich.; Hartford, Ct.; Lancaster, Pa.; Lawrence, Mass.; Portland, Me.; Utica, N. Y.; Worcester, Mass.; York, Pa. In 1850, Auburn, N. Y.; Columbus, O.; Easton, Pa.; Nashville, Tenn.; Pawtucket, R. I.; Pottsville, Pa.; Poughkeepsie, N. Y.; Salem, Mass.; Wheeling, Va.; and Williamsburgh, N. Y.

Since which time gas-light companies, in not only every part of this Union, but in South America and Central America, Mexico, and the British provinces, have been forming rapidly, and at this date the number of works in the United States alone exceed seven hundred, while the older civilization of the Antipodes has given way before the convenience and utility of this modern *illuminator*.

The recent organization of a guild of the practical men engaged in the production of gas, and representing the best scientific skill, and the most expert adaptation of all the methods and appliances known in its manufacture in the United States, may justly be said to form an

epoch in its history in this country. It will not be easy to overestimate the results possible from the Association, in respect to the future development alike in the scientific, practical and pecuniary point of view, of this great interest. Much, of course, will depend upon the zeal of its members, and their readiness to give for the common benefit, the results of their experience and investigations. As a means to aid such a desirable object the columns of the AMERICAN GAS-LIGHT JOURNAL are offered for the presentation of the facts and suggestions they may consider important and valuable

Petroleoducts.

The editor of the Philadelphia *Press* has strong hopes of living to see the day when illuminating gas will be supplied to different parts of the State of Pennsylvania, by means of pipes running from the oil regions. It is urged that the supply of this gas is as certain and abundant as that of coal, while the nature of its manufacture is as perpetual as that of water, and therefore no greater risk will be run in laying pipes for its conveyances to distant points than is now incurred in piping large cities to convey water, in bringing water from long distances, or in laying interminable tracks of iron to facilitate the transportation of material and agricultural products, bipeds and quadpeds. The idea seems quite as feasible, certainly, as the project which contemplates the construction of huge pipes to convey the oil from the tanks on Oil Creek to the great commercial centres of the country. This we believe is seriously entertained, a company being in process of formation for the purpose of laying down the necessary tubing. These projects appear somewhat chimerical, but they may nevertheless be perfectly feasible. The first would certainly render the Keystone State independent of gas monopolies, while the importance of the second to the great oil commerce of the country, could hardly be estimated in figures.

Prof. Henry Wurtz,

Scientific and Practical Chemist and Geologist.

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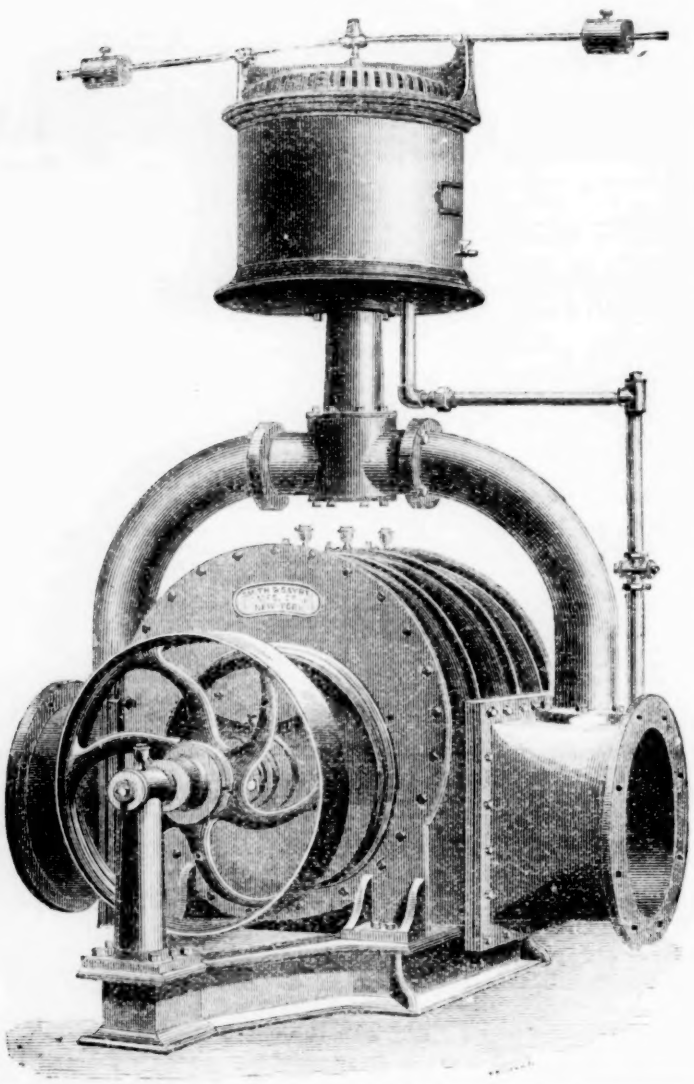

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I consider them *by far the best Screen* for Dry Lime Purifiers I have seen. Yours truly, A. M. NORTON, Supt.

CHELSEA, May 1, 1871.

Mr. E. DUFFEE.

We are using your Purifying Trays, and find them to be the *best of any* that I have used, and will *purify more gas with less pressure* than any tray that I know. I can fully recommend them, after four years trial, to any Gas Superintendent with perfect safety, as the *cheapest and best Tray made.*

Yours truly, JOHN ANDREW, Supt.

DORCHESTER, March 3, 1870.

Mr. E. DUFFEE.

Dear Sir: We have had your Gas Trays in constant use for almost one year and six months and find them superior to any others we have ever used, both in point of economy and efficiency. Truly yours, W. B. BROOKS,
Agent Dorchester Gas-Light Co.

JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, ESQ.

Dear Sir: The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, ESQ.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870.

EDWARD DUFFEE, ESQ.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT CO.
SPRINGFIELD, MASS., Oct. 10, 1871.

Mr. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, ESQ.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty per cent. more gas with them, than with any other Screen we have used.

Yours respectfully,
THOMAS J. PISHON

OFFICE DETROIT GAS-LIGHT CO.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING CO., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent.* more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give you my experience.

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P. E. DEMILL, Secretary.

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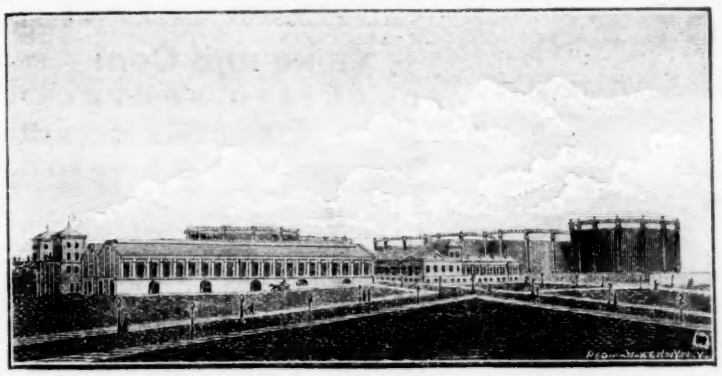

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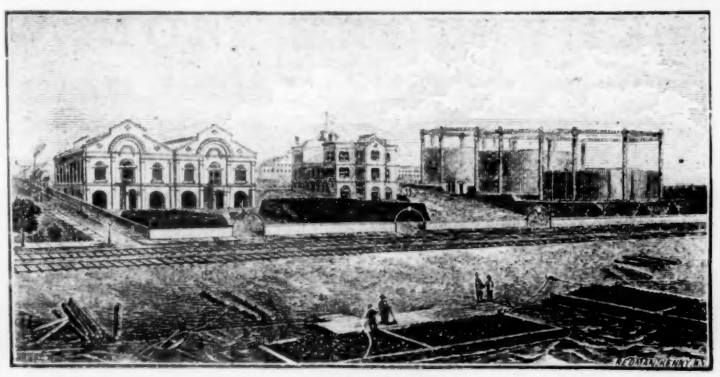

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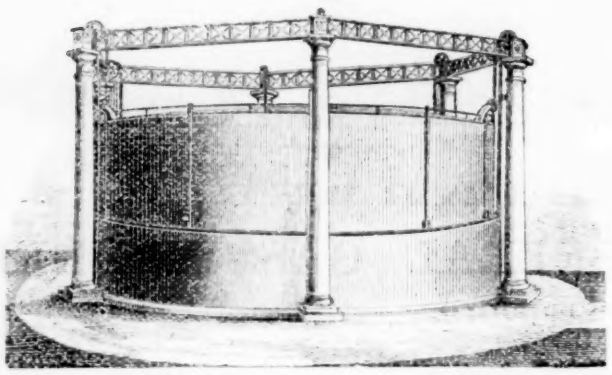

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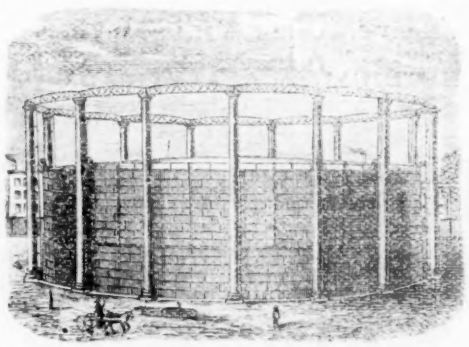

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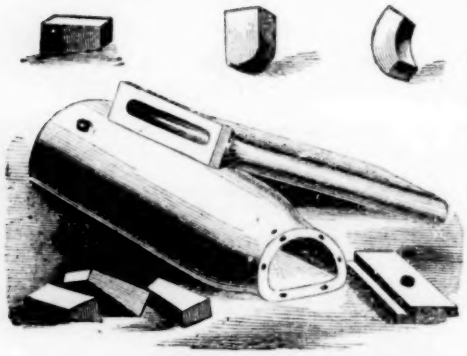

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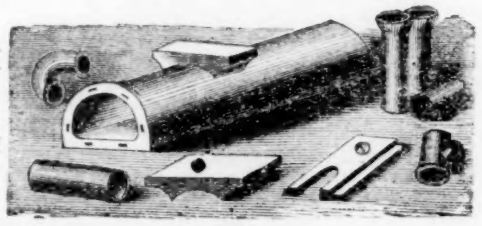

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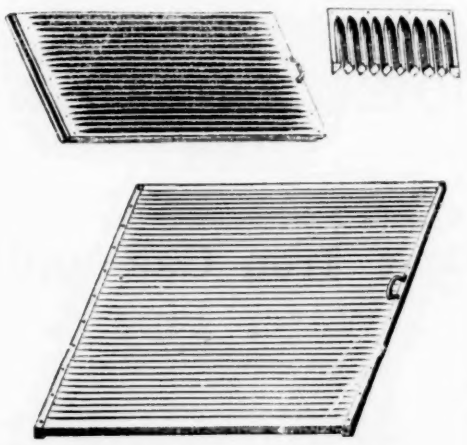

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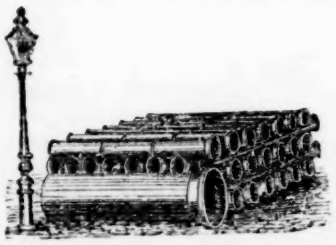

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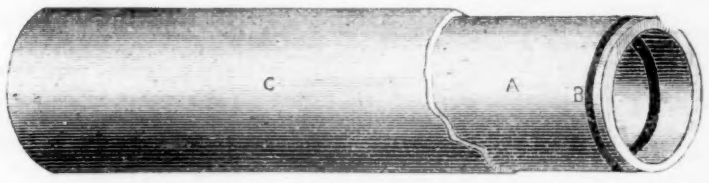

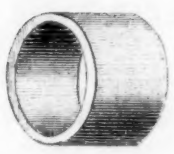

FIG. 2.

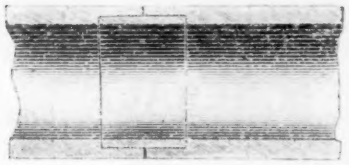

FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cement.

FIG. 2.—Thimble for Connection. FIG. 3.—Horizontal Section and Connection.

Above is a cut of the

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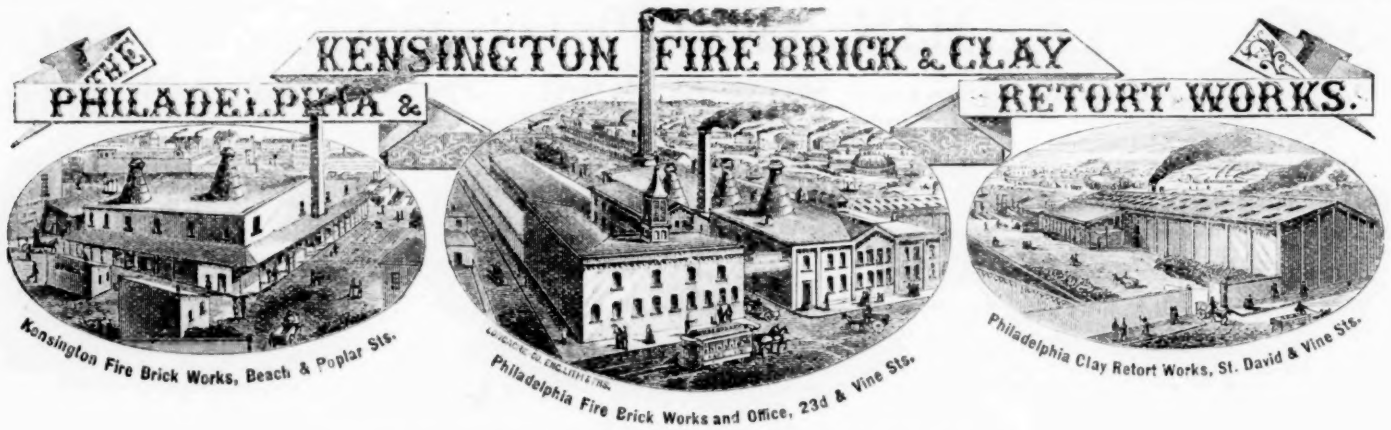
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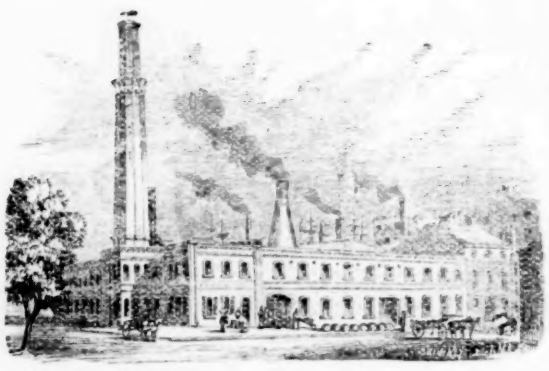

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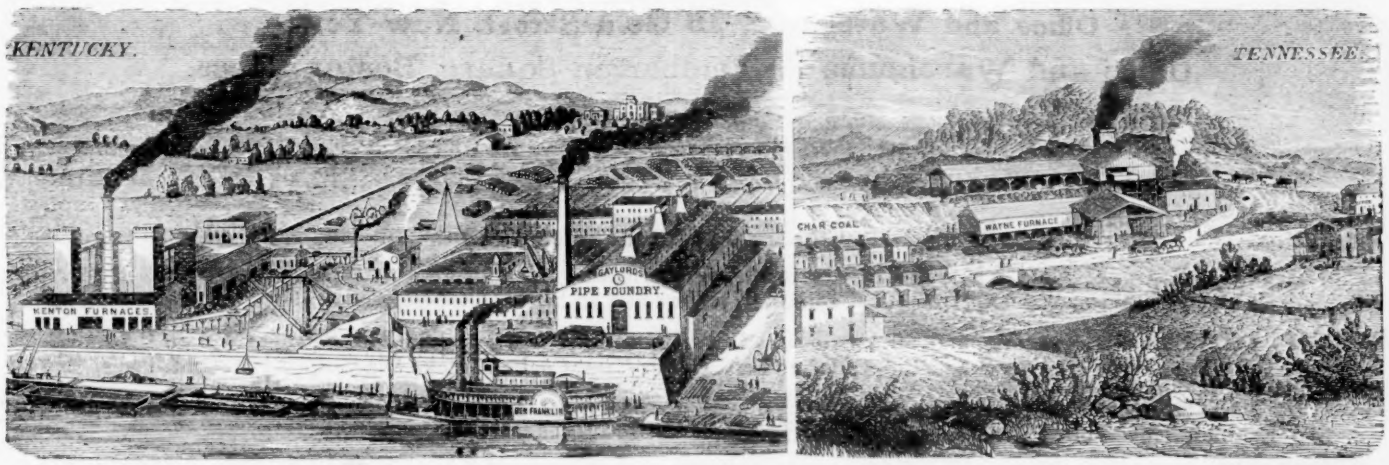

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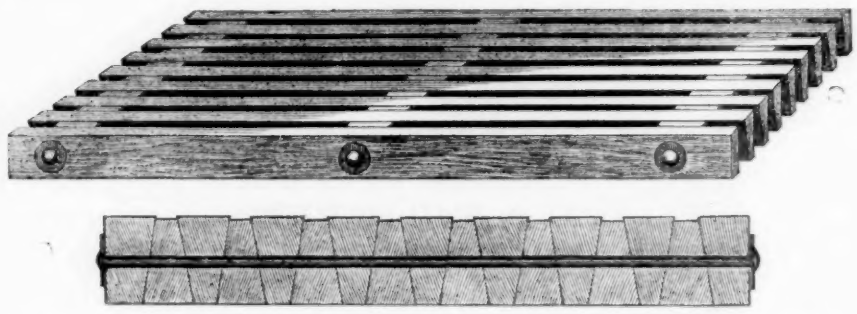

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Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.

New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas.
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Montclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.

Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York.
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich.
And numerous other Companies.